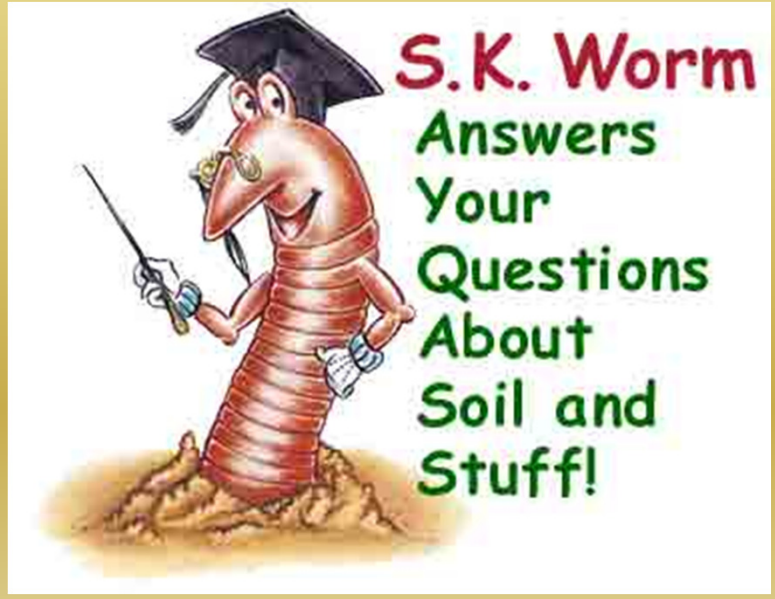
Renewable and Nonrenewable Resources

Soil, Water, Energy

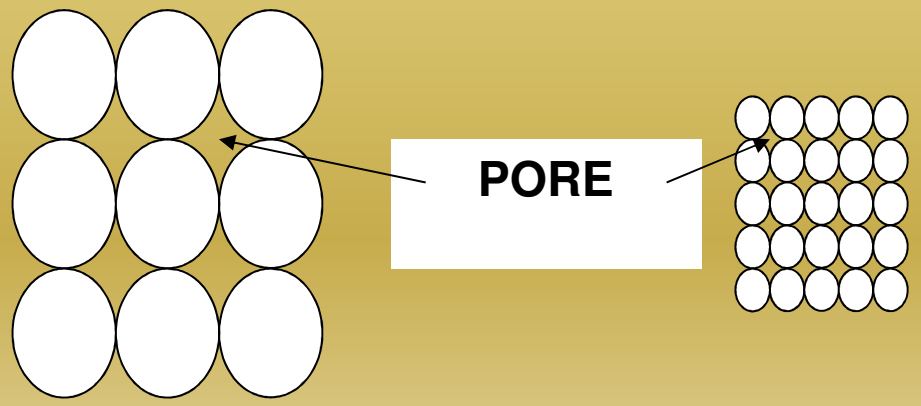
SOIL

- Soil Characteristics
- Soil Formation and Destruction
- Soil Preservation



Soil Characteristics

- ***Soil texture*** =
  - Describes size of soil particles
- ***Porosity*** =
  - Volume of air and water that soil can hold
  - Describes the size of the spaces between the particles



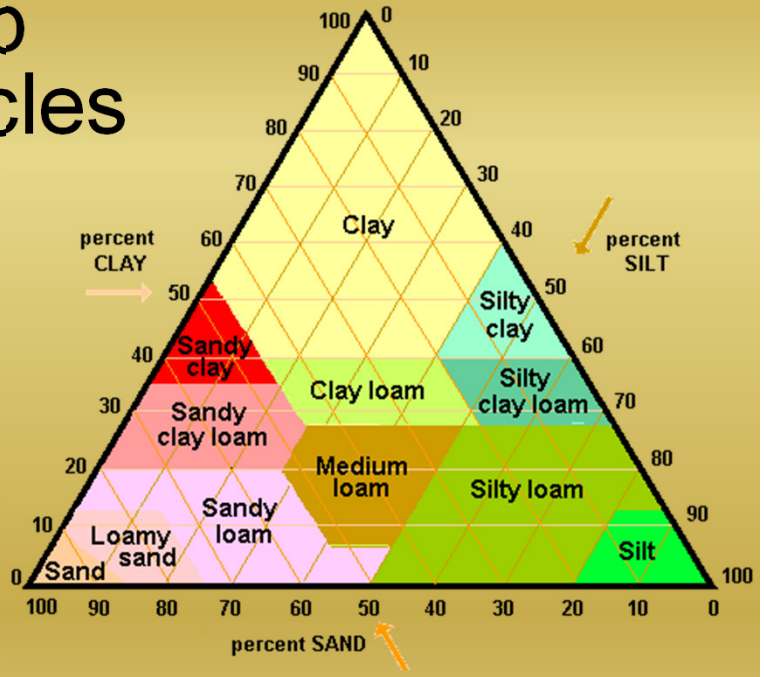
Large soil particles

Small Soil Particles

- Sand – largest particles
- Clay – smallest particles

- ***Silt*** =
  - Sediment that is made up of rock and mineral particles

- ***Loam*** =
  - Mixture of varying amounts of sand, silt, and clay



- ***Loess*** =
  - A fine, mineral-rich material that is composed of dust and silt

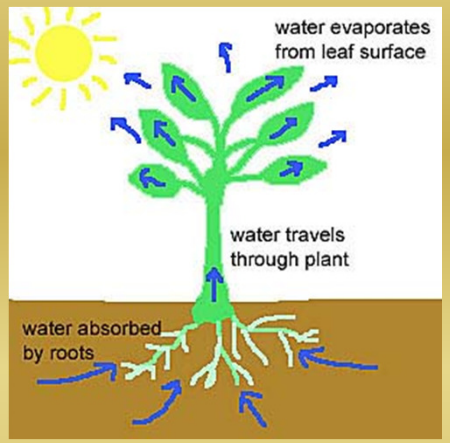
- Soil texture influences other soil properties
  - Large particles have larger spaces between them
  - Small particles have more surfaces for nutrients and water molecules to cling

- Soil texture also affects ***workability***
  - Ease with which soil can be cultivated
    - Clay soils are difficult to work
    - Sandy soils are easy to work

- ***Soil fertility*** =
  - Soil's ability to support plant growth

- ***Leaching*** =
  - Nutrients are dissolved and carried away by water moving through soil
  - Causes loss of soil fertility AND pollution

- ***Nutrient holding capacity*** =
  - Ability of soil to bind and hold nutrients
  - Options to improve
    - Fertilizers
    - Crop rotation



- ***Water-holding capacity*** =
  - Ability of soil to retain, or hold, water so that it will be available to plants
  - Important because of transpiration
    - ***Transpiration*** =
      - Loss of water vapor from plants

- ***Aeration*** =
  - Ability of soil to allow exchange of gases like CO_2 and O_2

  - Commonly blocked by 2 things
    - ***Compaction*** =
      - Packing down of soil until air spaces are gone
    - ***Water-logging*** =
      - Over-watering so all the spaces in the soil are filled with water

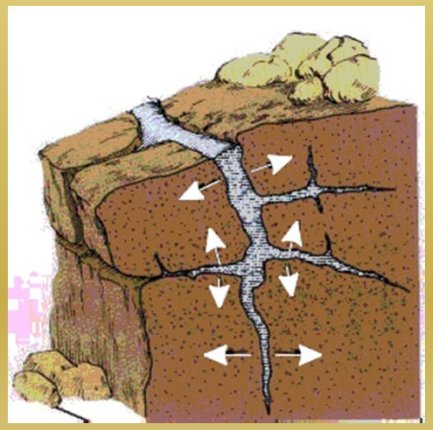
- ***Permeability*** =
  - The relative ease with which water and air can move through soil

Relationship between Soil Texture and Properties

Soil Type	Nutrient-holding	Water-holding	Aeration	Permeability	Workability
Sand	POOR	POOR	GOOD	GOOD	GOOD
Silt	MEDIUM	MED	MED	MED	MED
Clay	GOOD	GOOD	POOR	POOR	POOR
Loam	MEDIUM	MED	MED	MED	MED

Soil Formation and Destruction

- ***Weathering*** =
  - Slow, gradual breakdown of rock into smaller particles
    - It affects the rock in place, and no transfer is involved
  - ***Mechanical*** *or* ***physical weathering*** =
    - Breakdown of rock through temperature and pressure changes
      - Freezing, heating, thawing, cooling, wind, water, ice, pressure
  - ***Chemical weathering*** =
    - The decomposition of rock by the chemical breakdown of minerals



Mechanical Weathering


Sugarland Mountain, Great Smoky Mountains National Park, Tennessee May 2002

Chemical Weathering

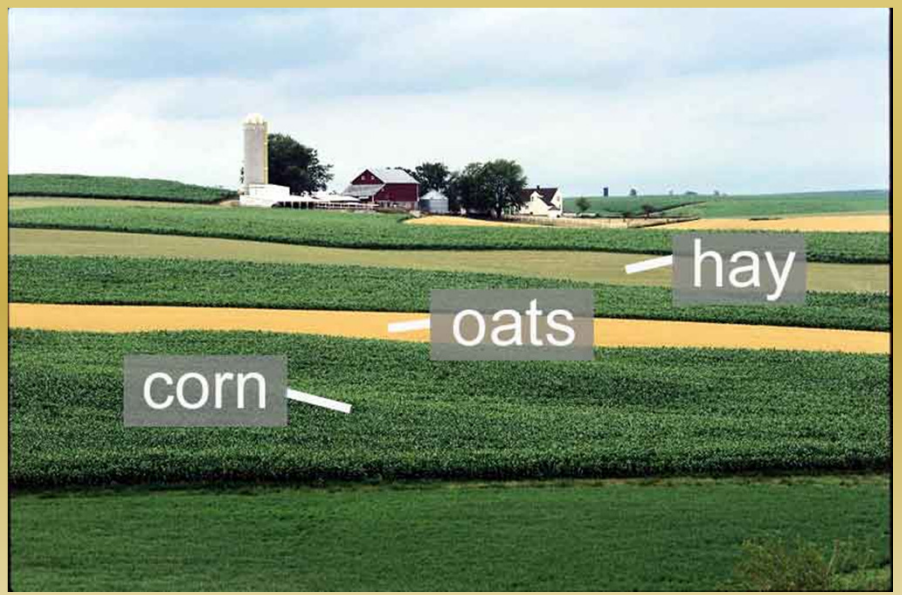
- ***Erosion*** =
  - Process by which soil particles are picked up and carried away by wind, water, or ice
- Soil is a RENEWABLE resource
  - The **weathering** of rock produces new soil
  - But **erosion** can result in soil loss
- Weathering and erosion work together to shape the surface of the Earth

Soil Preservation

- Planting a cover of grass and/or trees helps to reduce soil erosion
  - Soil helps provide plants with nutrients and water
  - Plants help to hold soil in place
- ***No-till agriculture*** =
  - Instead of plowing, weeds are killed with chemicals
  - Also minimizes soil compaction and may increase the amount of water in soil

- ***Contour farming*** =
  - Plowing and cultivating along the contour at right angles to the slope
- ***Terracing*** =
  - Grading of slopes into a series of steps so water does not run down the slope

- ***Strip cropping*** =
  - Cultivating alternate strips, generally leaving strips of grass or hay between
- ***Shelter belts*** =
  - Rows of trees planted around fields to slow the wind



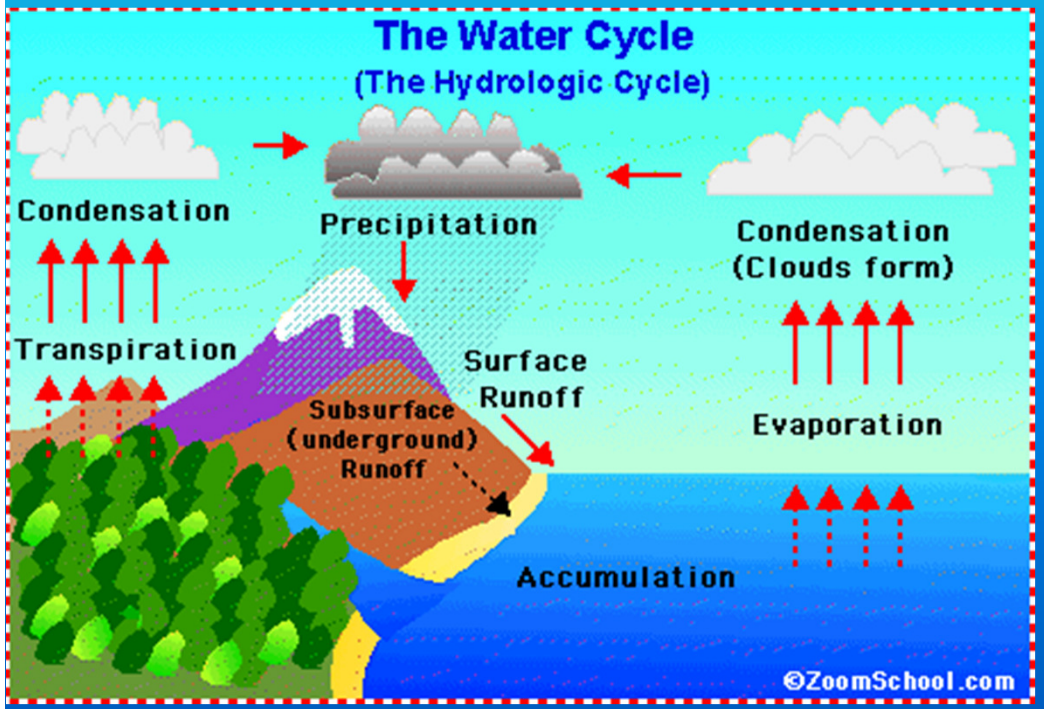
WATER

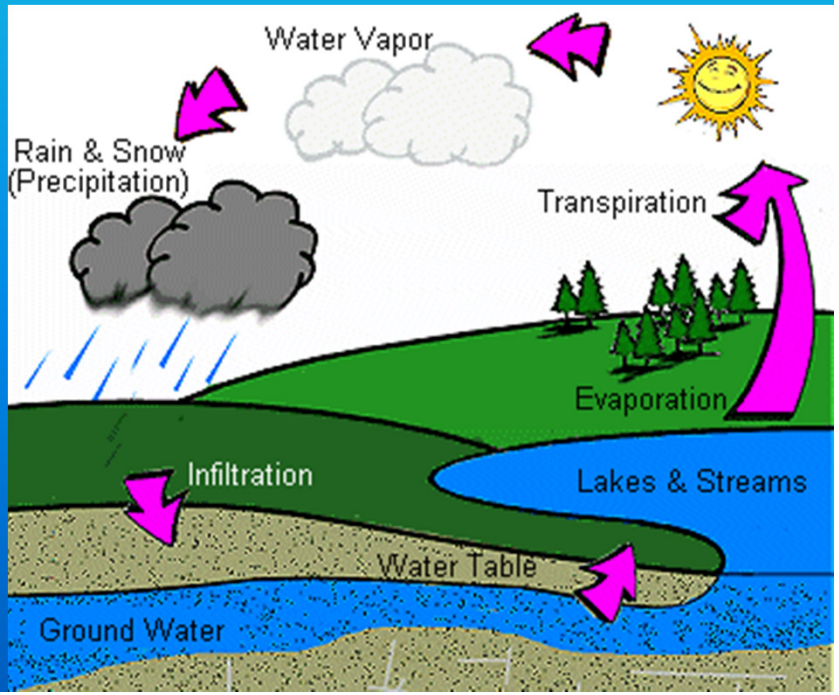
- Water Quality and Quantity
  - Water Conservation
  - Water Treatment
- Watersheds and Stream Order
- Aquatic Ecosystems

Water Quality and Quantity

- Over 70% of Earth's surface is covered with water
  - *97.5% of that is salt water*
  - *2.5% is fresh water*
    - *Only about 0.5% is actually available for our use*
- Water is a RENEWABLE resource
  - But it often needs to be treated and conserved

- ***Hydrologic cycle =***
  - Another name for the water cycle
    - Evaporation and transpiration
    - Condensation
    - Precipitation
    - Surface runoff vs infiltration





- ***Groundwater*** =
  - Water beneath the surface of the earth which saturates the pores and fractures of soil and rock
  - Renewed by infiltration of precipitation

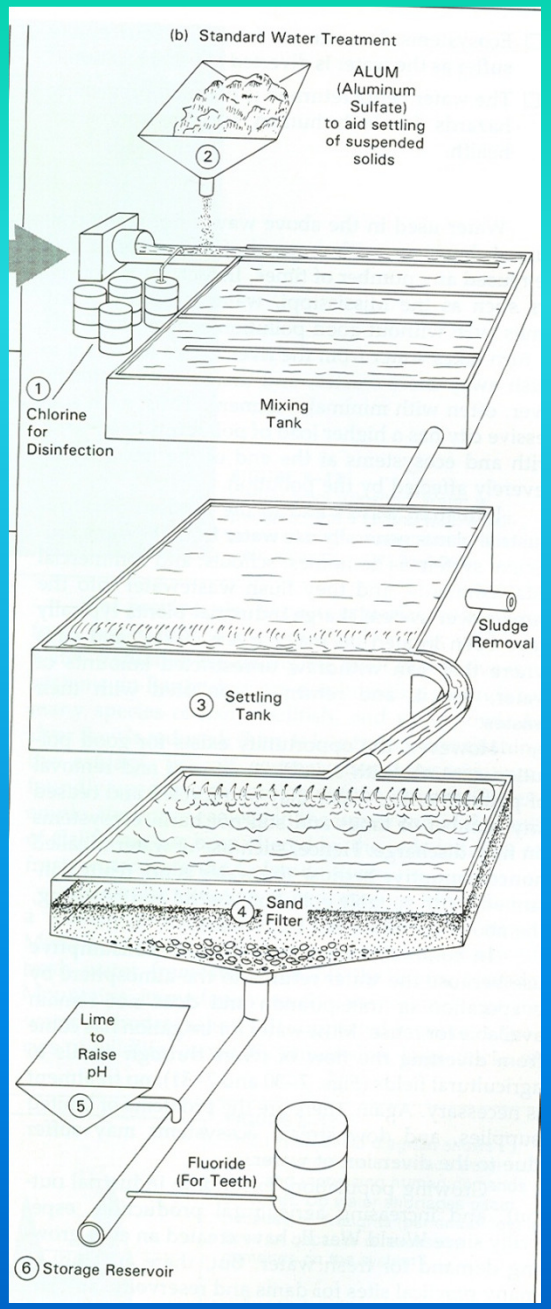
- ***Water table*** =
  - Upper surface of groundwater
  - When water table drops:
    - Water can't flow into wells
    - Land settles because support is lost, damaging foundations, pipes, roads

Water Conservation

- Monitor use of water in your own home
  - Take shorter showers
  - Don’t let the water run when you brush your teeth
  - Only run the dishwasher and washing machine when full
  - Collect and reuse rainwater for lawn/garden watering

Water Treatment

1. Chlorine for disinfection
2. Alum to clump
   organic particles
3. Settling basin
4. Sand filters
5. Lime to adjust pH
6. Storage reservoir



Water Filtration

Why do we need to filter water?

- Water from most sources contain bacteria and other microbiological organisms that can cause sicknesses and disease
- Water treatment plants clean water through the following processes
  1.) Aeration
  2.) Coagulation
  3.) Sedimentation
  4.) Filtration
  5.) Disinfection

Aeration

- This process adds air to the water and allows gases trapped in the water to escape.

Coagulation

- Water is treated with compounds that make dirt and other small, suspended solid particles stick together so they can be more easily removed from the water.

Sedimentation

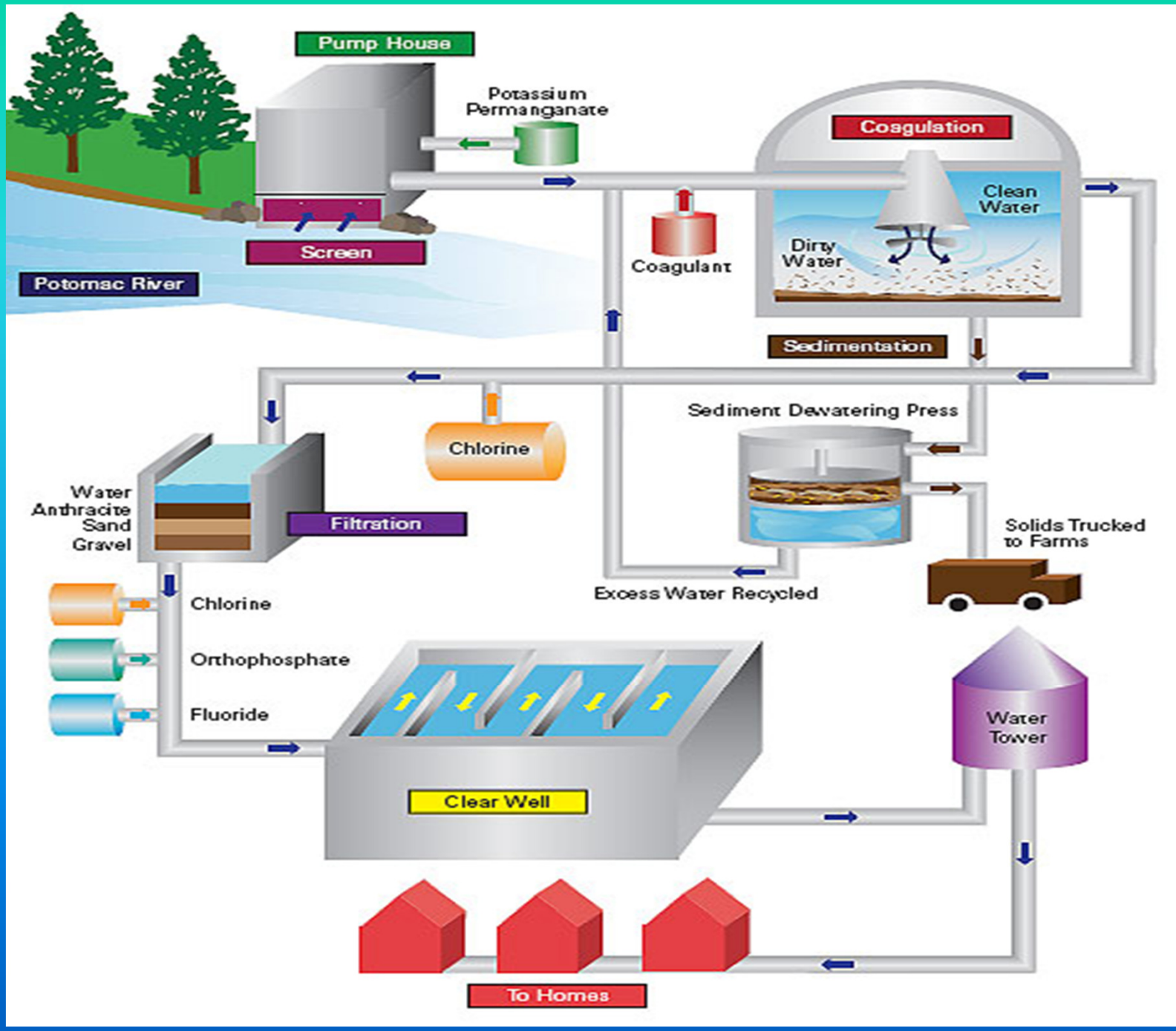
- Water is passed through a settling basin or clarifier allowing time for mud, sand, metals and other sediments to settle out as gravity pulls them to the bottom of the cylinder.

Filtration

- Water is passed through filters, which removes many of the remaining impurities.

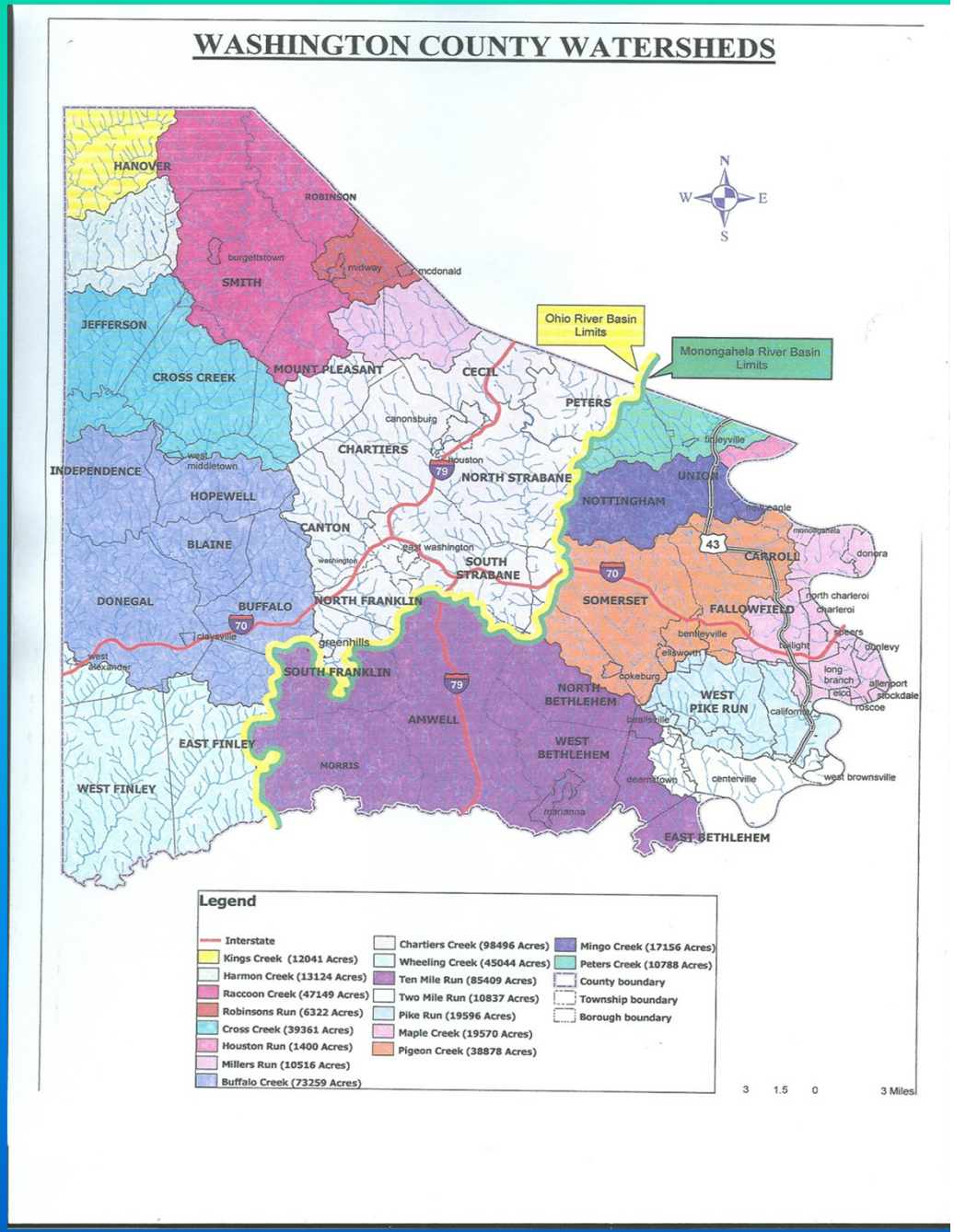
Disinfection

- Chemicals are added to the water to kill any organisms like bacteria.
- Types of chemicals used in this process include:
  - Chlorine
  - Chlorine Dioxide
  - Ozone (O3)
- Other chemicals may also be added
  - Fluoride


Pump House
Potassium Permanganate
Coagulation
Clean Water
Dirty Water
Coagulant
Screen
Potomac River
Sedimentation
Chlorine
Sediment Dewatering Press
Water
Anthracite
Sand
Gravel
Filtration
Solids Trucked to Farms
Excess Water Recycled
Chlorine
Orthophosphate
Fluoride
Water Tower
Clear Well
To Homes

Watersheds and Stream Order

- ***Watershed*** =
  - All the land area where water from precipitation drains into a certain body of water
  - The boundary of a watershed is formed by the topography of an area
    - Usually divided by hills and ridges



- ***Stream order*** =
  - A measure of the relative size of streams
  - Smallest **tributaries** are referred to as first-order streams
    - Perennial streams with no permanently flowing tributaries
    - IE-no other streams “feed” them
  - First through third order streams are called **headwater streams**
    - Over 80% of the total length of Earth's waterways are headwater streams
  - **Rivers** are considered seventh-order or larger
    - Largest river in the world, the Amazon, is a twelfth-order waterway

- ***Perennial streams*** =
  - Water flows in the stream at least 90 percent of the time in a well defined channel
- ***Intermittent streams*** =
  - Flow generally occurs only during the wet season (50 percent of the time or less)
- ***Ephemeral streams*** =
  - Flow generally occurs for a short time after extreme storms and the channel is usually not well defined

Why are watersheds and stream orders important?

- What happens in one watershed affects water quality on a much larger scale
  - Small watersheds are part of larger watersheds
- Examining the stream network helps to:
  - Narrow down the location of any potential pollutants
  - Determine what types of aquatic organisms can inhabit a particular stream

AQUATIC ECOSYSTEMS

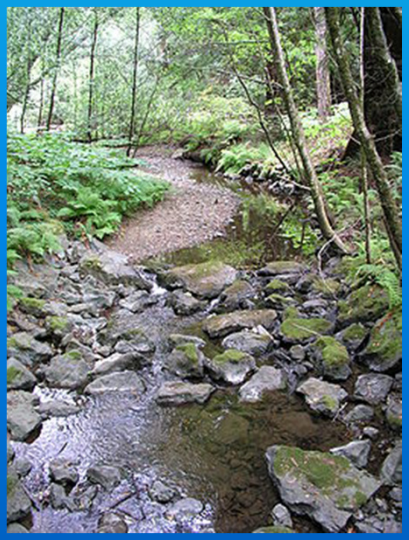
Types of Aquatic Ecosystems

- Freshwater (2.5% of the world's water)
  - Lentic
  - Lotic
  - Wetlands
- Marine (contain 97% of the world's water)
  - Oceanic Zone
  - Benthic Zone
  - Intertidal Zone
  - Estuaries
  - Salt Marshes
  - Coral Reefs

Freshwater Systems

- ***Lentic*** =
  - – Ecosystems of slow water movement
    - Lakes
    - Ponds

- ***Lotic*** =
  - – Ecosystems of rapid water movement
    - Rivers
    - Streams
    - Creeks



- ***Wetlands*** =
  - An area of land whose soil is saturated with moisture either permanently or seasonally
  - Examples
    - ***Bogs***
      - Spongy peat deposits in standing water
    - ***Marshes***
      - Dominated by grasses (fresh water)
    - ***Swamps***
      - Flooded forests

– Function and value of wetlands

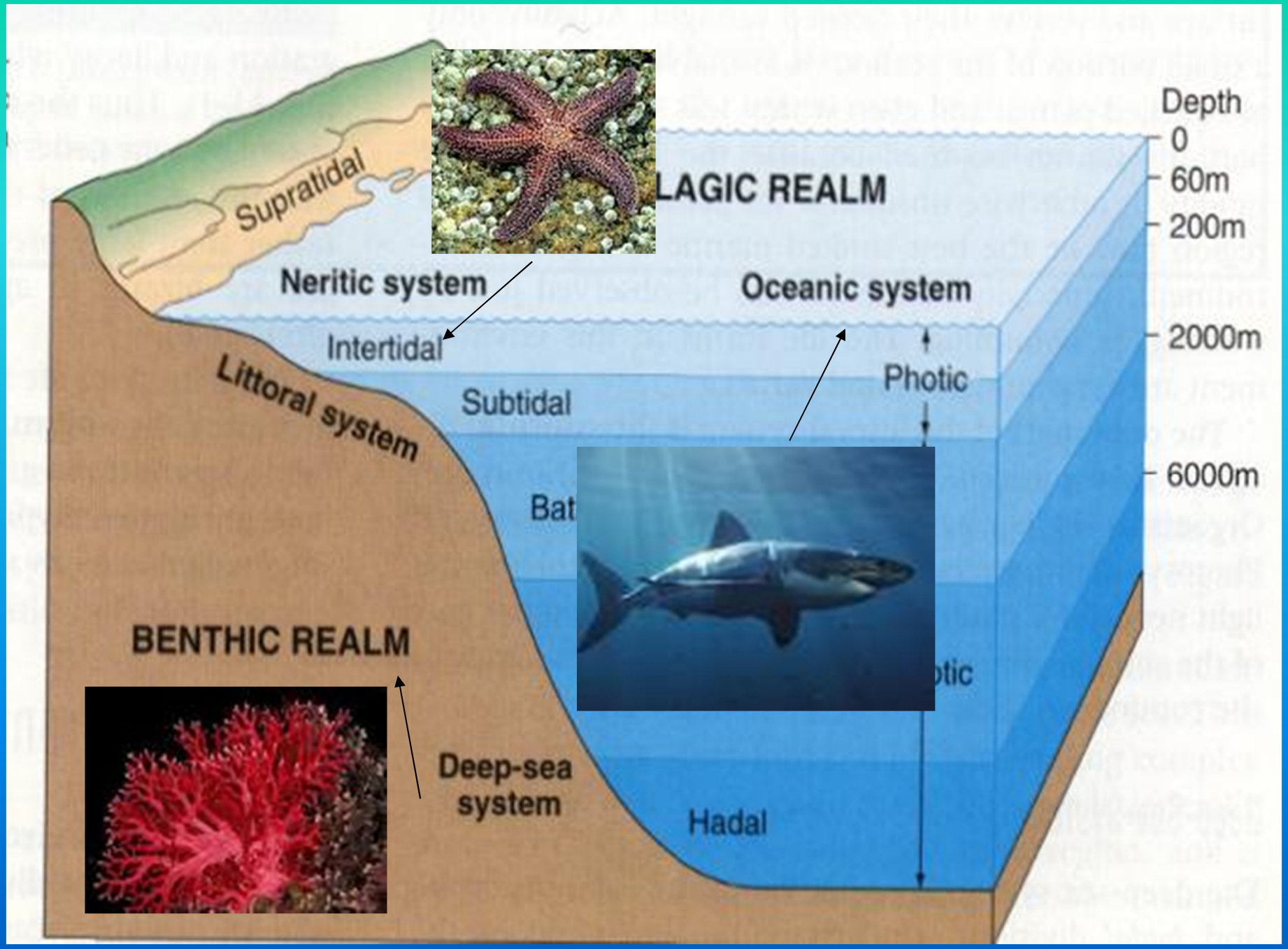
- Protection from storms
- Absorb and store water
- Flood control
- Habitat for diverse wildlife
- Filter and purify water
- Air quality
- Irrigation
- Recreation
- Commercial resources
- Nurseries for many species

Marine

- ***Oceanic Zone*** =
  - Vast open part of the ocean
  - Animals such as whales, sharks, and tuna live here

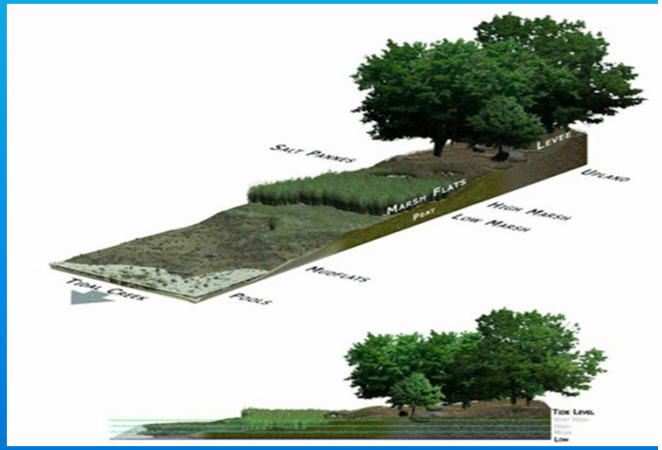
- ***Benthic Zone*** =
  - Begins at shoreline and extends along continental shelf
  - Organisms usually live close or attached to the sea floor
  - Organisms here must be adapted to deep water pressure

- ***Intertidal Zone*** =
  - Area between high and low tide
  - Will be covered by the sea AND exposed to the air depending on the tide
  - Organisms living here must have adaptations for both wet and dry conditions


Supratidal
LAGIC REALM
Neritic system
Oceanic system
Intertidal
Littoral system
Subtidal
Photic
Bat
BENTHIC REALM
Deep-sea system
Hadal
Depth
0
60m
200m
2000m
6000m

- ***Estuaries*** =
  - Mixture of fresh and salt water formed where rivers meet the sea
  - Spawning and nursery grounds

- ***Salt Marshes***=
  - Coastal ecosystem between land and open ocean
  - Dominated by brackish water and regularly flooded by tides



- ***Coral Reefs*** =
  - World's most diverse marine ecosystems
  - Some are greater than 4500 years old
  - Slow growing
  - Largest
    - Great Barrier Reef
  - Built by cnidarians
    - Reproduce asexually by budding
    - Skeleton remains behind when coral dies
  - 3 types of reefs
    - Fringing reef
    - Barrier reef
    - Atoll

Fringing Reef

Barrier Reef

Atolls

PARROTFISH

"In the end we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught" - Baba Dioum

Energy Resources

- Fossil Fuels
  - Coal
  - Oil
  - Natural Gas
- Nuclear
- Renewable

Advantages of Fossil Fuels

- Fossil fuels are relatively inexpensive
- Many technologies already exist which use fossil fuels as the primary energy source
- It is fairly easy to release large amounts of energy from these fuels through burning

- Advantages of Oil over Coal
  - Petroleum fueled engines and oil furnaces are more convenient
  - Air quality is better
  - New engines have better power-to-weight ratio

- Advantages of Natural Gas
  - Burns more cleanly than coal or oil

Disadvantages of Fossil Fuels

- It takes millions of years to form fossil fuels
  - From ancient organisms that died and were buried under layers of sediment
- Fossil fuels are NONRENEWABLE
  - Supplies are limited
  - We must conserve them or we will run out
- Fossil fuels cause pollution when burned

- Drawbacks of COAL
  - Hazardous to mine
  - Dirty to handle
  - Burning coal results in ashes that need removed
  - Boilers heated by coal were large, bulky

Photo credit:
American Coal Foundation

- Drawbacks of OIL
  - Expensive to purchase from other countries
  - Political problems in the Middle East
  - Environmental concerns with drilling in the US (Alaska) and oil spills

Advantages of Nuclear Power

- Does not release pollutants into the atmosphere
  - Nuclear power does not contribute to global warming
- Uses a small amount of fuel to release a large amount of energy
  - There is enough uranium to fuel nuclear reactors well into 21st century

Disadvantages of Nuclear Power

- Also NONRENEWABLE
- Radiation
  - Meltdowns are unlikely but disastrous
  - Waste must be sealed up and buried for thousands of years
- Can become expensive
  - Because of maintaining safety standards
  - Corrosion and embrittlement of pipes

Renewable Energy Resources

- Solar power (sun)
- Wind power
- Hydroelectric power (falling water)
- Geothermal power (heat from underground)
- Tidal power
- Wave power
- Biomass (organic materials)
- Other biofuels (for vehicles [from organic materials])